TEXAS A&M AGRILIFE EXTENSION

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AIR QUALITY

Standards and Nuisance Issues for Animal Agriculture

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The concentration of large numbers of livestock and poultry confinement facilities, which began several decades ago, has become common practice in the animal industry. Until recently, the operators of animal feeding operations, or AFOs, did not have much knowledge about the Clean Air Act (CAA) and its implications for animal agriculture. Now, however, air quality standards are being strictly enforced.

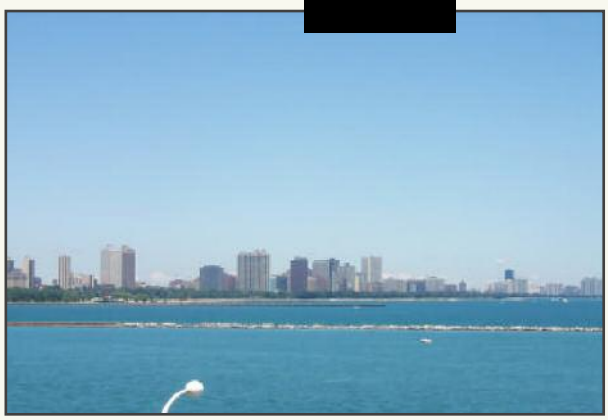

FIGURE 1

Chicago in the summer of 2000: a clear day (left) with $PM_{2.5}$<5µg/m^3; and a poor visibility day (right) with $PM_{2.5}$~35µg/m^3. (Source: USEPA http://www.epa.gov/airnow/2003conference/presentations2003/Paisie.pdf, accessed February 21, 2006)

National Ambient Air Quality Standards

Air pollution is categorized as a **health concern** for humans, animals or plants when, for example, an amount of pollutants in the air is considered to be harmful. It can also be a nuisance because of odors interfering with the enjoyment of life or normal use of property.

The first national legislation to deal with air pollution was the Air Pollution Control Act of 1955, which was followed by the Air Quality Act of 1967. Three years later came the CAA Amendment, an important piece of environmental legislation intended to curb air pollution—particularly smoke and smog—from large, industrial cities. This legislation required the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS).

The NAAQS were developed for six "criteria pollutants" that the EPA considered to be common throughout the United States:

- Carbon monoxide (CO),
- Lead (Pb),
- Nitrogen dioxide (NO_2),
- Ozone (O_3),
- Particulate matter (PM) and
- Sulfur dioxide (SO_2).

These pollutants were called criteria pollutants because they were based on two criteria: **primary standards** to protect public health; and **secondary standards** to protect public welfare, such as decreased visibility (Figs. 1 and 2) and damage to animals,

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crops, vegetation and buildings. Table 1 lists the primary and secondary standards for these criteria pollutants.

Because different pollutants have different effects on public health and welfare, the NAAQS for these criteria pollutants are also different. Some pollutants have standards for *long-term* and *short-term* averaging times. The short-term standards protect against acute or short-term health effects, while the long-term standards guard against chronic health effects. The amounts of these pollutants are reported as concentration in parts per million (ppm) by volume, or as mass concentration in milligrams per cubic meter (mg/m^3) and micrograms per cubic meter ($\mu g/m^3$) of air.

FIGURE 2

Reduced visibility because of PM emission from animal feeding operations.

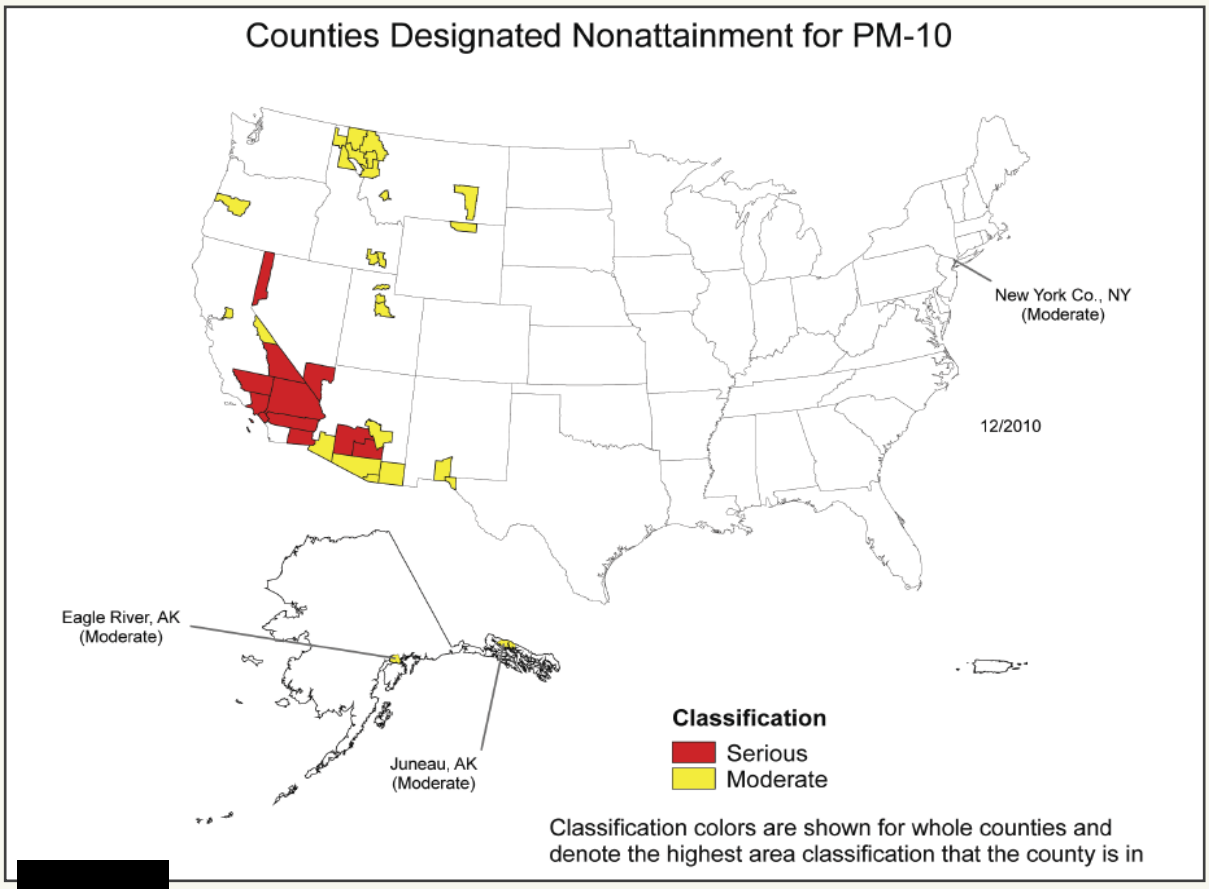

FIGURE 3

PM non-attainment area map. (Source: USEPA, http://www.epa.gov/air/oaqps/greenbk/mappm10.html, accessed February 2, 2011)

Table 1 shows that all criteria pollutants except carbon monoxide have primary and secondary standards. In 1997, the EPA divided particulate matter into two categories (PM_{10} and $PM_{2.5}$) to designate different size particles. $PM_{2.5}$ is also known as PM fine (Table 1).

Throughout the United States, a network of approximately 4,000 State and Local Air Monitoring Stations (SLAMS) provide air quality data to determine if regions are meeting or exceeding the NAAQS. A geographic area is deemed a "non-attainment area" if the NAAQS for a certain criteria pollutant is exceeded. Regions staying at or below the NAAQS are known as "attainment areas."

Figures 3 and 4 illustrate both categories for two criteria pollutants: PM_{10} and ozone. Western states, especially California and Arizona, are classified mostly as serious non-attainment states for PM_{10} (Fig. 3). Large urban areas in several states, including

Houston, Los Angeles, and Dallas, are considered non-attainment areas (Fig. 4) for the 8-hour ozone standard.

The EPA, state and regional pollution control agencies have been monitoring air quality and reporting emissions for criteria pollutants since the 1970s. Data in Table 2 indicate that the emissions of individual pollutants have decreased steadily over time and that the total emissions of these pollutants in 2009 were less than half of what they were in 1980.

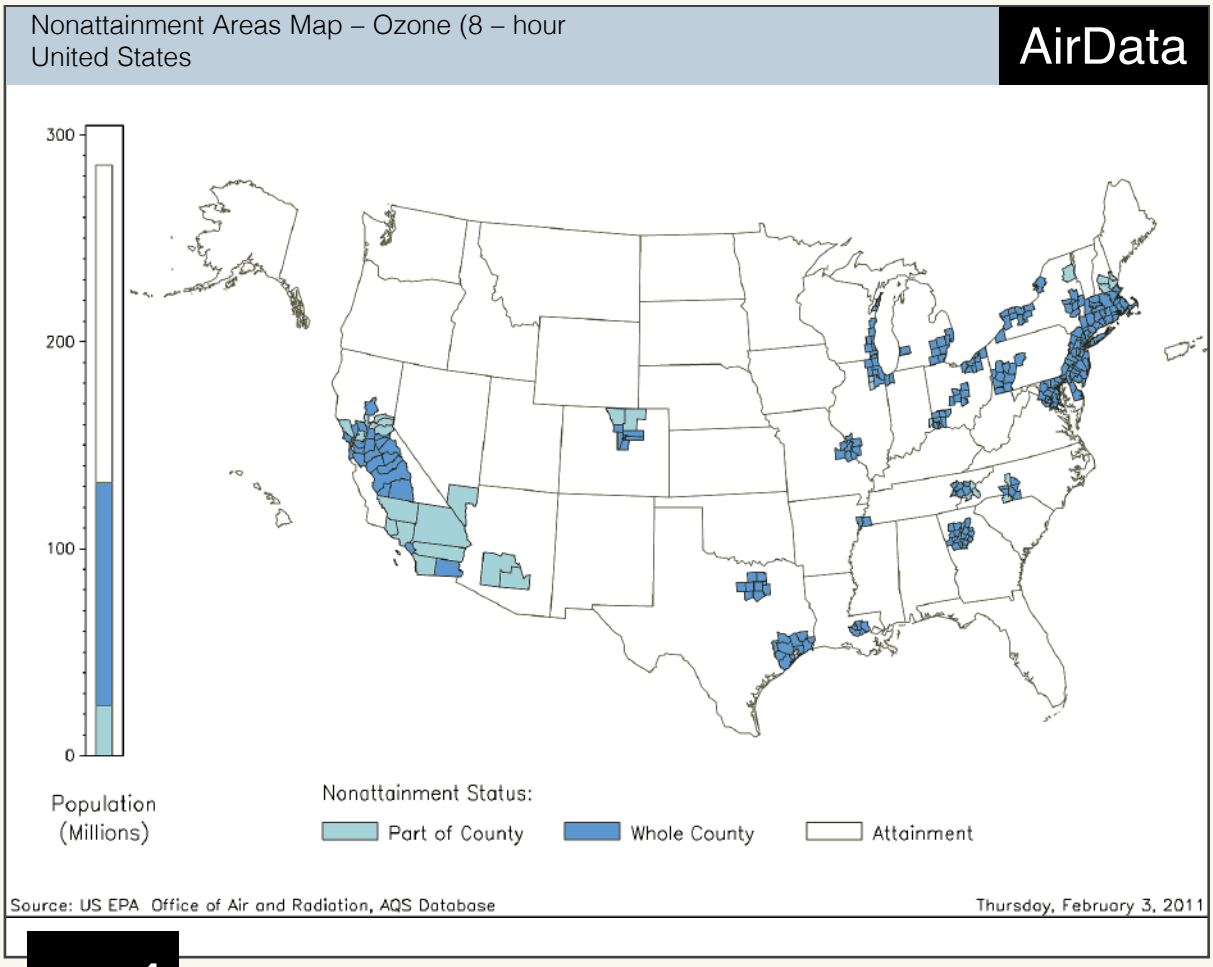

FIGURE 4 **Ozone non-attainment area map.**

In 1990 the CAA was amended, authorizing the EPA to fine violators. The act contains eleven separate titles for addressing air quality issues. One of them is Title V.

EPA and state air pollution regulatory agencies (SAPRA) grant Title V permits to operate major, stationary sources of pollution. An AFO, or any other operation, is considered a major, stationary source of emission if it has the potential to emit more than the annual emission threshold for a criteria pollutant. Major sources must pay an annual fee on every ton of regulated pollutant emitted, including fugitive emissions.

Fugitive emissions are to air what non-point source emissions are to water and cannot be measured at the end of a pipe or orifice. For example, if a source is subject to Title V permitting because of its PM_{10} emissions, then it must pay annual fees on all other criteria pollutants (e.g., So_x, NO_x and O_3) that it may emit.

Hazardous Air Pollutants (HAPs)

The EPA also considers substances such as volatile organic compounds (VOCs), pesticides and herbicides as toxic air pollutants. It maintains a list of these substances on its web site (http://www.epa.gov/air/toxicair/newtoxics.html, accessed Feb. 8, 2006). Toxic air pollutants, also known as hazardous air pollutants (HAPs), cause—or are suspected to cause—serious health effects (e.g., cancer and birth defects) or adverse environmental effects.

Two particular gases, ammonia (NH_3) and hydrogen sulfide (H_2S), are not listed as HAPs. However, H_2S is included in the CAA [section 112-9(r)] and is subject to accidental release provisions. Higher emissions of NH_3 may cause the formation of ammonium aerosol, which reacts with acids (e.g., nitric or sulfuric acid) in the atmosphere and contributes to the formation of $PM_{2.5}$ or soil and water acidification.

Ammonia and Hydrogen Sulfide Reporting Requirements

Since January 2009, one federal rule has required reporting NH_3 and H_2S emitted from point sources at large AFOs. Examples are exhaust from confinement structures, such as a mechanically ventilated barn, and manure storage/treatment structures, such as lagoons. This reporting requirement falls under the Emergency Planning and Community Right-To-Know Act (EPCRA).

This legislation is not part of the CAA, but the rule requires that releasing these two contaminants above a "reportable quantity" be reported. The reportable quantity for NH_3 and H_2S is 100 pounds within any 24-hour period. EPCRA fines violators $27,000 and $10,000 per violation, respectively. A description of EPCRA rule and what size AFOs may be exempt from reporting requirement is provided by the EPA EPCRA CAFO Reporting fact sheet at

TABLE 1

NATIONAL AMBIENT AIR QUALITY STANDARDS

	Primary standards		Secondary standards	
Pollutant	**Level**	**Averaging time**	**Level**	**Averaging time**
Carbon monoxide	9 ppm (10 mg/m^3)	8-hour(1)	None	
	35 ppm (40 mg/m^3)	1-hour(1)		
Lead	0.15 µg/m^3(2)	Rolling 3-month average	Same as Primary	
	1.5 µg/m^3	Quarterly average	Same as Primary	
Nitrogen dioxide	53 ppb(3)	Annual (arithmetic average)	Same as Primary	
	100 ppb	1-hour(4)	None	
Particulate matter (PM_{10})	150 µg/m^3	24-hour(5)	Same as Primary	
Particulate matter ($PM_{2.5}$)	15.0 µg/m^3	Annual(6) (arithmetic average)	Same as Primary	
	35 µg/m^3	24-hour(7)	Same as Primary	
Ozone	0.075 ppm (2008 std)	8-hour(8)	Same as Primary	
	0.08 ppm (1997 std)	8-hour(9)	Same as Primary	
	0.12 ppm	1-hour(10)	Same as Primary	
Sulphur dioxide	0.03 ppm	Annual (arithmetic average)	0.5 ppm	3-hour(1)
	0.14 ppm	24-hour(1)		
	75 ppb(11)	1-hour	None	

Current National Ambient Air Quality Standards (NAAQS) for criteria pollutants. (Source: USEPA, http://www.epa.gov/air/criteria.html), accessed February 2, 2011).

NOTES

1 *Not to be exceeded more than once per year.*

2 *Final rule signed October 15, 2008.*

3 *The official level of the annual nitrogen dioxide standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.*

4 *To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb (effective January 22, 2010).*

5 *Not to be exceeded more than once per year on average over 3 years.*

6 *To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m^3.*

7 *To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m^3 (effective December 17, 2006).*

8 *To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm. (effective May 27, 2008).*

9 *(a) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm. (b) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as EPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard. (c) The EPA is in the process of reconsidering these standards (set in March 2008).*

10 *(a) The EPA revoked the 1-hour ozone standard in all areas, although some areas have continuing obligations under that standard ("anti-backsliding") (b) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is <1.*

11 *Final rule signed June 2, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb.*

http://www.epa.gov/osweroe1/docs/chem/CAFO_rule_fact_sheet.pdf (accessed February 2, 2011).

Odors

Unlike criteria pollutants, HAPs and other toxic air contaminants, odors are not federally regulated under the CAA. Generally, SAPRAs and/or local, regional or municipal authorities regulate odors under the nuisance standard.

Texas and most other states indirectly regulate odors through setbacks, permitting, operator training and land-application restrictions. A few states require direct methods, using rules and standards that prohibit the release of odors above odor detection thresholds which are measured at the AFO or which are determined in the laboratory from odorous air samples.

Summary

Operators of concentrated animal feeding operations face increased scrutiny and accountability for the extent to which their facilities may impair air quality for their neighbors and communities. That accountability can involve nuisance complaints, law-

TABLE 2

NATIONAL AIR POLLUTANT EMISSIONS ESTIMATES

Millions of tons per year

	1980	1985	1990	1995	2000	2005	2009
Carbon monoxide	178	170	144	120	102	93	70
Lead	0.074	0.023	0.005	0.004	0.003	0.002	0.002
Nitrogen oxides	27	26	25	25	22	19	14
Volatile organic compounds	30	27	23	22	17	18	13
Particulate matter							
PM_{10}	6	4	3	3	2	2	1
$PM_{2.5}$	NA	NA	2	2	2	1	1
Sulfur dioxide	26	23	23	19	16	15	9
Totals	267	250	218	189	159	147	107

U.S. EPA national air pollutant emissions estimates (fires and dust excluded) for criteria pollutants. (Source: USEPA, http://www.epa.gov/oar/airtrends/aqtrends.html#comparison, accessed February 2, 2011)

NOTES

[1] *In 1985 and 1996, the EPA refined its methods for estimating emissions. Between 19770 and 1975, the EPA revised its methods for estimating PM emissions.*

[2] *The estimates for 2005 and beyond are from the final version 2 of the 2005 NEI.*

[3] *For carbon monoxide, nitrogen oxides, sulfur dioxide, and volatile organic compound emissions, fires are excluded because they are highly variable; for direct particulate matter emissions, both fires and dust are excluded.*

[4] *PM estimates do not include condensable particulate matter.*

[5] *The EPA did not estimate $PM_{2.5}$ emissions before 1990.*

[6] *The 1999 estimate for lead is used for 2000, and the 2002 estimate for lead is used for 2005 and 2009.*

[7] *$PM_{2.5}$ emissions are not added when calculating the total because they are included in the PM_{10} estimate.*

suits, increased permitting burdens, novel or stricter applications of existing law, new municipal ordinances, or state and federal regulations. It is a complicated, multi-faceted challenge that will require AFO operators to stay abreast of developments and new precedents on all of those fronts.

In the meantime, operators should become familiar with fundamental air quality principles, which will help them devise innovative strategies or adapt existing techniques to reduce the air quality impact of their facilities. This will also enable them to anticipate how management techniques to reduce one air pollutant might create or intensify problems with another air pollutant. Producers should educate their neighbors and communities about these issues where possible so that they can reduce the likelihood of destructive, expensive confrontations over nuisances or regulatory violations.

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